



Annual Reports :: Year 6 :: University of California, Los Angeles

Project Report: Early Earth's Atmosphere, Oceans and Life

Project Investigator:

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Project Progress

Establishment of the biogenicity of ancient putative microscopic fossils, the challenging problem of unambiguously distinguishing true biologic remnants from nonbiologic look-alikes, is crucial both to understanding the early history of life on Earth and for detection and characterization of past life on other planets. To address this problem effectively, there is need for means to demonstrate in such objects a one-to-one correlation at a micron scale of distinctive "biological morphology" with assured "biological chemistry." By showing that individual putative "microfossils" are composed of carbonaceous matter, as would be expected of organically preserved microorganisms, such means would provide evidence supportive of a biogenic interpretation — an interpretation that would seem all but irrefutable were the data to establish that the carbonaceous matter was unquestionably of biological origin. Our studies, carried out over the past year using laser-Raman imagery, provide a way to solve this problem. This work has already not only yielded new insight into the chemistry of the kerogen comprising individual ancient organic-walled microscopic fossils, but for the first time has provided means to "chemically map" the cellular structure of such fossils *in situ*, both in two and in three dimensions. To extend this work, a new state-of-the art Raman facility is being installed in my laboratories (supported by ~\$500K of UCLA's "matching funds" for this NASA Astrobiology grant). Additionally, by use of confocal microscopy, we have just recently developed novel means to produce three-dimensional *optical* images of individual rock-embedded microscopic fossils (a problem heretofore widely assumed insoluble).

In sum, we are now prepared to produce optical and chemical images — in both two and in three dimensions — of individual rock-embedded ancient microorganisms. For the first time, distinctive "biological morphology" can be directly correlated with assured "biological chemistry at a micron scale in minute individual fossilized microorganisms."

Highlights

- New means have been devised to produce optical and chemical images — in both two and in three dimensions — of individual rock-embedded

ancient microscopic organisms.